



DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

JUN - 8 1995

CEPR-P (715)


MEMORANDUM FOR COMMANDER, ALL MAJOR SUBORDINATE COMMANDS,
DISTRICT COMMANDS, FIELD OPERATING ACTIVITIES
AND LABORATORIES, ATTN: DIRECTOR/CHIEF,
CONTRACTING DIVISION

SUBJECT: PARC Instruction 95-7 - Other Than Full and Open
Competition

1. Reference FAR 6.3.
2. The purpose of this PARC Instruction 95-7 is to provide a recently approved Justification and Approval (J&A) for other than full and open competition.
3. The enclosed J&A is an excellent example of the elements to be considered in a J&A and should be used as a sample in J&A preparation.

FOR THE COMMANDER:

Encl


KENNETH J. LOEHR
Principal Assistant Responsible
for Contracting

JUSTIFICATION FOR OTHER THAN
FULL AND OPEN COMPETITION

1. Contracting Agency. The contracting agency responsible for this procurement action is the U.S. Army Engineer Waterways Experiment Station (CEWES), Vicksburg, MS.

2. Description of Action. This is a new contract action for the sole source procurement of ABAQUS/General from Hibbitt, Karlsson & Sorensen, Inc. Funds are available for the annual lease fee. The estimated life-cycle cost is \$543,864.00

3. Description of Supplies/Services. This is a new contract for the licensing and support of a proprietary operating system utility. The proprietary software will be used by customers of the DoD High Performance Computing (HPC) Shared Resource Center (SRC) at CEWES for advanced structural and heat transfer analysis to meet ongoing mission-critical milestones.

Modeling tools must include one-, two-, and three-dimensional continuum elements as well as beams, membranes and shells. Elements should be formulated to provide accurate modeling for arbitrary magnitudes of displacement, rotations, and strains. The software must have the capability to remove and add elements during an analysis; and when adding elements, must be able to place the elements in a stress free state. Models must be provided for metals, rubber, plastics, composites, concrete, sand, clay, jointed rock, and resilient and crushable foam. Anisotropic material properties must be allowed. Models for general elastic, elastic-plastic, and elastic-viscoplastic analysis must be provided, as well as standard design theories for high temperature creep/fatigue evaluation of thin-walled piping components. An elastic-plastic fracture theory must be provided for concrete. The ability to extend the capabilities in the program and provide user-defined material models via user-supplied subroutines must be provided. The following types of analysis must be available:

a. Linear and non-linear static analysis, including stress-displacement analysis.

b. Linear dynamic analysis, including:

- (1) Determination of natural modes and frequencies
- (2) Response spectrum analysis
- (3) Time history response
- (4) Steady-state response to harmonic loading
- (5) Dynamic response to random loadings
- (6) Stress-displacement analysis

c. Transient nonlinear dynamic analysis, including stress-displacement analysis

d. Creep and swelling analysis

- e. Eigenvalue buckling load prediction
- f. Transient and steady-state heat transfer analysis
- g. Sequentially and fully coupled temperature-stress analysis
- h. Fully coupled piezoelectric analysis
- i. Steady-state and transient coupled effective stress/groundwater flow analysis for consolidation problems involving fully or partially saturated flow
- j. Fully coupled acoustic medium/structural vibration analysis
- k. Mass diffusion analysis
- l. A complete fracture mechanics design evaluation capability
- m. There should be no built-in limits on problem size. Smaller problems should run entirely in main memory. Buffering to secondary storage must occur automatically as the problem size increases.
- n. Program must also include modules designed specifically to serve advanced nonlinear continuum and structural analysis needs, including highly nonlinear transient dynamic phenomena and certain linear and non-linear quasi-static simulations. In order to solve highly transient dynamic phenomenon the program must have explicit time integration procedures implemented in a Lagrangian formulated finite element program. The program must provide capabilities for advanced contact surface algorithms for modeling impacts and sliding between multiple surfaces of different materials. The program must also provide the capability to include Equations of State and user specification of material behavior. (ABAQUS/Explicit)
- o. Program must also include modules designed specifically for analyzing the effects of underwater shocks on structures. (ABAQUS/USA)
- p. Require an interactive, graphical postprocessing module for the finite element code. Capabilities should include model plotting, deformed geometry plotting, contours of results, animation, and x-y plotting. Printed output and the interactive interrogation of the model and results must also be provided. (ABAQUS/Post)

4. Authority Cited. The statutory authority permitting other than full and open competition for this procurement is 40 USC 759 (g), as amended.

5. Reason for Authority Cited. The ABAQUS/General software provides unique, proprietary capabilities needed by DoD scientists and engineers for performing advanced structural and heat transfer analysis. The requirement for this package originates with the DoD decision to consolidate HPC resources and eliminate obsolete sites. The requirement for the ABAQUS software still exists and is documented in the DoD HPC Modernization Program Requirements Analysis dated April 1994. Two components of the ABAQUS/General package, ABAQUS/Explicit and ABAQUS/USA, provide capabilities that cannot be met by any other source.

a. The ABAQUS/Explicit module provides explicit time integration procedures implemented in a Lagrangian formulated finite element program. The explicit solution is used to solve large (+100,000 degrees of freedom), highly non-linear problems (i.e., material and geometric non-linearity with contact) and is required for safety/crash and blast response problems currently being investigated by the U.S. Army Tank Automotive Command, Warren, MI and the Structures Laboratory at CEWES. As these large problems become highly non-linear, the implicit solution technique requires excessive resources (large amounts of central memory, and long execution times), or will not converge to a solution. The ABAQUS/Explicit module will require fewer system resources to solve a large problem.

b. The ABAQUS/USA module includes the capability to analyze the effects of underwater shocks on structures. This capability is required primarily by the Navy for studies of shock attenuation within a submerged vehicle and predicting responses to underwater explosions.

c. ABAQUS/Standard is currently the only numerical model available which can satisfy the requirements for performing a nonlinear, incremental structural analysis (NISA) on massive concrete structures constructed by the U.S. Army Corps of Engineers as required by the official Corps of Engineers guidance document, ETL 1110-2-365, "Non-linear Incremental Structural Analysis of Massive Concrete Structures". The NISA procedure is a detailed structural analysis tool which is used by the structural engineer to determine combined effects of thermal and mechanical loads while the material properties are changing with time and to check for cracking within the structures. These requirements stem directly from a Government Accounting Offices (GAO) report made in the early 1980's which stated that the Corps of Engineers was not using state-of-the-art methods in performing thermal stress analysis of massive concrete structures and mandated improvement in analytical methods for these evaluations. As a result of the GAO report, CEWES initiated an effort to develop a state-of-the-art thermal-mechanical model for analyzing massive concrete structures. The criteria included the capability to simulate incremental construction, a large element library, the capability to implement user-defined material models with relative ease, the capability to model significant numbers of reinforcing bars with relative ease, and an efficient numerical solution procedure with flexible means

for selecting solution time steps. It was determined that ABAQUS was the only code which met all of these specifications. NISA's have been performed in the past and numerous others are scheduled in the future. Past NISA's using ABAQUS include Melvin Price Locks and on the lock portion of the Olmsted Locks and Dam project on the Ohio River. The NISA analysis on the Melvin Price project produced a construction cost savings of \$1,200,000.00 and a savings of \$1,000,000.00 to \$5,000,000.00 is expected on the Olmsted project. Failure to procure ABAQUS will jeopardize the ability to perform NISA's on future projects.

6. Efforts to Obtain Competition. When this information requirement was identified and the support mission for the R&D requirements were transferred to CEWES, all available commercial and government sources were researched for compatible operating system utilities/routines. While this research identified potential new vendor sources, the majority were excluded because they were not executable on the CRAY C916 and did not have the underwater shock analysis (ABAQUS/USA) or explicit time integration procedures (ABAQUS/Explicit). The commercial research sources that were used were the DATAPRO Computer Systems Analyst service, the COMPUSERVE information service, and the 1994 Directory of Application Software for Cray Research Supercomputers catalog. The government/contract research sources were the Army High Performance Computing Research Center and the Minnesota Supercomputer Center.

7. Actions to Increase Competition. The DoD HPC community is continually seeking new and better solutions to its R&D problems. This search primarily entails using the commercial market sources, groups, and councils to explore new ways and means for solving HPC problems. Additionally, this procurement will be done for one year with options for two additional years in order to allow CEWES to re-evaluate the market annually, especially the possibility that the ANSYS Software may have developed the necessary capabilities that were indicated as a result of the market survey (see Para 8). This reflects an ongoing commitment by DoD to foster competition at all levels and reflects the current policy and thinking of the CEWES.

8. Market Survey. On 12 April 1995, a synopsis was published in the Commerce Business Daily (CBD) stating the intention of the CEWES to purchase ABAQUS/General from Hibbitt, Karlsson & Sorensen, Inc., Pawtucket, Rhode Island. The synopsis contained the functional specifications described in Paragraph 3 above and its intended use by DoD. One response to the synopsis was received by the CEWES Contracts Division. Engineering Cybernetics, Inc., San Antonio, TX, an authorized reseller of ANSYS indicated that the ANSYS software was virtually identical to ABAQUS. Several copies of their literature were sent to the CEWES Contracts Division, and then distributed to the DoD technical community. After thoroughly reviewing the materials, two deficiencies were noted - no underwater shock analysis and no explicit time integration procedures.

A conference call was held on 28 April 1995 with representatives of

Engineering Cybernetics, Inc., ANSYS, Inc., Ms. Ruth Little and Mr. Jack Little of the CEWES Contracts Division, and Ms. Virginia Sotler and Mr. Barry Fehl of the CEWES Information Technology Laboratory. The ANSYS representative admitted that they currently did not have an explicit time integration procedure, but that development was currently underway and would be available by the end of CY 95. An underwater shock analysis could be developed and available by the end of CY 95 if DoD required that capability. Ms. Sotler informed ANSYS that there are mission critical projects that could not wait until December 1995 to continue work and that the target installation for ABAQUS/General is June 1995. Both the representative from ANSYS, Inc. and Engineering Cybernetics, Inc. agreed that their software could not meet the current requirement and that this sole-source procurement should continue.

9. Interested Sources. No other sources responded to the CBD synopsis.

10. Other Factors.

a. Procurement History.

1. The ABAQUS/Standard portion of ABAQUS/General has been in use on the CRAY Y-MP at CEWES for over five years. Use of ABAQUS/Standard on the Y-MP is restricted to CEWES users only. Furthermore, the CEWES Structures Laboratory has identified a requirement for ABAQUS/Explicit to model the nonlinear response of hardened structures subjected to blast loads.

2. The U.S. Army Tank Automotive Command (TACOM) is currently running ABAQUS on a CRAY-2. TACOM has a requirement to solve large highly non-linear problems for safety/crash and blast response problems. The size of the problems require CPU and disk resources that exceed the capabilities of the CRAY-2 at TACOM. The ABAQUS license at TACOM could be transferred to CEWES, but access would be restricted to TACOM users only.

3. The Navy currently has a service-wide contract in place for ABAQUS. Twelve Navy sites currently using the HPC resources at CEWES have a requirement for ABAQUS. Five sites require ABAQUS/Explicit and four sites require ABAQUS/USA; all twelve sites require ABAQUS/Standard. Two Navy sites have obtained annual leases (using their own project funds) thru that contract and are currently running ABAQUS/Standard and ABAQUS/USA on the C916 at CEWES. Access is restricted to those organizations.

b. This contract for ABAQUS/General will enable any DoD user who is authorized to use the HPC resources at CEWES to use the software as needed to meet their project milestones. The alternative of requiring individual sites to obtain their own license for the ABAQUS products they need is costly and contrary to the goal of consolidating HPC resources. A single license for ABAQUS/General is the most cost-effective way to satisfy the DoD requirement for ABAQUS.

11. Technical Certification. I certify that the supporting data under my cognizance which are included in the J&A are accurate and complete to the best of my knowledge and belief.

Name: Virginia Sotler

Date: 18 May 1995

Title: Computer Scientist

Signature: Virginia A. Sotler

12. Requirements Certification. I certify that the supporting data under my cognizance which are included in the J&A are accurate and complete to the best of my knowledge and belief.

Name: Stephen A. Adamec, Jr.

Date: 5/18/95

Title: Program Manager, HPC

Signature: S. A. Adamec, Jr.

13. Fair and Reasonable Cost Determination. I hereby determine that the anticipated cost for this contract action will be fair and reasonable. Price analysis will be used to determine reasonableness of price.

Name: William M. Landes

Date: 18 May 95

Title: Supervisory
Contract Specialist

Signature: William M. Landes

14. Procurement Contracting Officer Certification. I certify that this J&A is accurate and complete to the best of my knowledge and belief.

Name: William M. Landes

Date: 18 May 95

Title: Contracting Officer

Signature: William M. Landes

APPROVAL

Based on the foregoing justification, I hereby approve the procurement of ABAQUS/General from Hibbitt, Karlsson, & Sorensen, Inc., Pawtucket, Rhode Island on an other than full and open competition basis pursuant to the authority of 40 USC 759 (g), as amended, subject to the availability of funds, and provided that the services and property herein described have otherwise been authorized for acquisition.

Date:

8 June 95

Bert A. Millikin

BERT A. MILLIKIN, CPCM
Special Competition Advocate